

SYSTEM AND DEVICE FOR OBJECT DETECTION AND IDENTIFICATION USING GAMMA, X-RAY  
AND/OR NEUTRON RADIATION

5           **TECHNICAL FIELD**

The invention belongs to systems of identification of remote objects by detection of gamma, X-ray and neutron radiations, in particular, to systems allowing to identify objects that are concealed or forbidden to transport, for example, at customs, border check-points etc.

10           **BACKGROUND ART**

The hand-held radiation detector, (CZT spectrometer) [1, 2], designed by Los Alamos National Lab. is known. Cadmium-Zinc-Tellurium (CZT) semiconductor detector is used in this detector that is capable to identify gamma and neutron radiation of radioactive materials. In real time he produces precise data for the portative device, insensitive to a temperature variation of the environment. The detector includes CZT chip installed in a housing with charge-sensitive amplifier and input-output unit for spectrum analyzing, as well as a multichannel analyzer with a microcontroller. In this device the specialized software linking to built-in microcontroller and monitoring operations in CZT spectrometer is used.

20           Disadvantage of this device is placement of gamma and X-rays detector in one housing with hand computer, which does not allow keeping under the control several sensing devices.

25           The multi-channel analyzer is known [3], designed to conveniently gather, process, and distribute spectrographic pulse data. The multi-channel analyzer may operate on a computer system having memory, a processor, and the capability to connect to a network and to receive digitized spectrographic pulses. The multi-channel analyzer may have a software module integrated with a general-purpose operating system that may receive digitized spectrographic pulses for at least 10,000 pulses per second. The

multi-channel analyzer may further have a user-level software module that may receive user-specified controls dictating the operation of the multi-channel analyzer, making the multi-channel analyzer customizable by the end-user. The user-level software may further categorize and conveniently distribute spectrographic pulse data employing  
5 non-proprietary, standard communication protocols and formats

The analog imperfection is limitation of functional capabilities of final device that includes only reception, signal coding from the sensor and its transmission through multichannel communication line, including Internet signal, corresponding to received signal spectrum.

10 There is known hand-holdable, battery-operated, microprocessor-based spectrometer gun includes a low-power matrix display and sufficient memory to permit both real-time observation and extended analysis of detected radiation pulses. Universality of the incorporated signal processing circuitry permits operation with various detectors having differing pulse detection and sensitivity parameters [4].

15 The system of a remote radiation control and objects identification [5] containing a stationary detection system of fissionable and nuclear materials, connected with relevant information monochannel with personal computer having a display device, information and signalling recording system, with the capability of an information transfer by means of information channels, which is supplied with the videosystem device, connected with video images synchronization device and to fissionable and nuclear materials readings recorder (with a timer) is taken as a prototype.  
20

The imperfection of the known system is in its stationary state — only the objects passing through window of fixed system can be checked, and it is impossible for authorized person to leave a place of observation, having kept the system without control. Moreover the system selected as the prototype, is closed and does not permit to  
25 use additional resources, and also to work simultaneously with different types of detectors.

### **DISCLOSE THE INVENTION**

The task of the present invention is to create mobile and simultaneously high-

capacity object detection and identification system according to its gamma, X-ray and/or neutron radiation. Moreover, invention task is to make it possible to develop distributed multilevel system, for departmental usage, and open system for common usage.

5        This task is solved as follows: as per present invention, device object detection and identification by their gamma X-ray and neutron radiations containing the detection unit, preprocessing unit with display, microprocessor, input unit and connecting unit with the expert system, -- the detection unit is created separately with micro controller and data transfer device, preprocessing unit is supplied with the channel for data  
10       acquisition from detection unit, and the preprocessor includes the spectrums analysis unit.

The problem put by is solved as follows: the communication link with the expert system of objects identification is equipped additionally with the channel for bilateral transfer of audio and video information.

15       The problem put by is solved as follows: the portable computer with connected radiotelephone or other mobile information reception and transfer device, for example, smart phone, or portable computer, is used as preprocessing device.

The problem put by is solved as follows: the preprocessing unit is supplied additionally with a video information input unit, for example, with video camera.

20       The problem put by is solved as follows: several detection units are used, each of them is supplied with an identification marker and they interact with preprocessing unit.

The problem put by is solved as follows: the detection unit and preprocessing device are made in one housing, and the detection unit is changeable.

25       The problem put by is solved as follows: known system of objects identification by gamma, X-ray and neutron radiation includes detection unit and information preprocessing unit of two hierarchic parts, one of which is the expert system, located in a networks, and they are interconnected by communication link, -- according to the invention, expert system is connected by communication link with national and/or de-

partmental emergency warning system activated in case of emergency situations.

The problem put by is solved as follows: in the expert system there is additionally a person — expert in the field of objects identification.

Device construction in the form of divided in space on separate, interconnected  
5 modules by communication link, where the detection unit is realized with separate micro controller, allows to receive such implicit advantages, for example, as object identification directly in the place where it is, irrespective of identification place and object complexity. The size of detection unit with a microcontroller can be small and it can be placed in the given place of control zones. Moreover, the departmental network allows  
10 executing control of all authorized experts staff operation from one working place. Information processing capabilities in every specific situation rise considerably owing to porting of previously adjusted expert system. It is enough to have one central data file for all preprocessing devices servicing, that allows to make data renew and actualization for all users simultaneously

## 15 DESCRIBE THE FIGURES

The invention is illustrated by drawings.

The version of system use in special testing zones is showed in Fig. 1. The scheme of devices interaction in objects registration and identification system is given in Fig. 2. Block diagrams of preprocessing unit are given in Fig. 3.

20 Objects registration and identification device includes the detection unit (DU) 1, preprocessing unit (PPU) 2 with a display and input unit, departmental expert system (DES) 3. The devices are connected in a local network (LN). The expert system can be located in a open network, for example, open expert system in Internet (OES) 4. The system can contain national or other state or intergovernmental system of emergency  
25 warning (NSEW) 5. When system is used at the customs terminal the detection units 1 can be installed in the check points 6, passengers passages (green corridor) 7 and in places of transport thoroughfare 8. At that the preprocessing unit 2 is located at authorized person (not shown). The preprocessing unit 2 includes display unit D 9 and information input device (ID) 10, which can be realized as keyboard or graphical input

(graffiti); processor (P) 11 and interface units (IU) 12. There is specialized software in P, which carries out the following actions:

### **THE BEST MODE CONTEMPLATED**

5 Selection performance parameters (search, measurement and accumulation of scintillation spectrums);

Identification of a connected DU 1 under its identification number;

Information interchange with DU 1 and information output in D 9;

Objects identification according to accumulated scintillation spectra;

10 Information exchange through IU 12 with exchange interfaces of Blue Tooth or WI-FI with DES usage or through GSM with GPRS and OES usage.

The device is supplied with a unit of the wireless link 13 with the detection units 1 (for example, IrDA or Blue Tooth) and connection unit 14 (for example, GSM) with DES expert system 3 or OES 4. Preprocessing unit 2 can include a scanner (SC) 15 and information video-audio input unit (VAU) 16.

15 The device and system work in the following way.

The detection unit 1 can be used as the independently operating device supplied with the microprocessor controller and information transfer devices, and also together with PPU device 2 (which can be any of portable devices (Mobile Device) - smart phone, notebook, communicator etc.). DU 1 should be handled by persons taking a control of gamma, X-ray and neutron radiation sources (RS), or be installed in the specially assigned places. These inspectors should stay in special control zones (customs and/or frontier zones) or in supposed places of RS occurrence (airports, railway or sea-ports, places of people gathering, control check points of materials, foodstuffs etc.).

25 Registration of gamma, X-ray and neutron radiation in search mode is carried out in zones, in which joint action with additional equipment applied for RS check in these zones is possible: transport, foot-passengers or luggage monitors. At determination in RS control zone, the detection signal is transmitted over transmission channels preprocessing unit/units 2, where automatic initial identification of this source with the help of PPU 2 intrinsic computing resources occur. If the user is not able at his own

make a decision about the danger of the arisen situation or there are no PPU computing resources 2, for example, the received spectrum is absent in the CPC database, then the user can contact to the higher hierarchic expert system (by local network when working with the departmental expert system DES 3 or by GPRS or IP when working with expert system located in common user network OES 4). In this case expert system starts to control user's actions, sending the instructions to him and receiving the results of his actions (measured values, accumulated spectrums, etc.). The obtained data are processed by DES 3 or OES 4 and are returned as user instructions for additional monitoring or RS identification. All user actions are saved in the database and can be inspected by the expert after addressing to him. If there are not enough DES 3 resources 3, the system connects with the expert in the field of objects identification, which can demand additional actions or information from user, including information on RS over video channel.

Structurally OES or DES are constructed identically, and differ only by arrangement (or in corporate (local) DES network or in OES Internet) and by data and information bases. By the request, the user (authorized person) gets instructions from OES or DES, following which a decision on the further actions is made. In the case of non-typical situations, when OES or DES are not able to make a decision, the experts from crisis centers are linked up to operation, having analyzed all user actions and theirs results, direct further actions and make a decision on the arisen situation hazard.

In a DU 1 there is a built-in honker, which can be used independently (without PPU) or can be switched - off at the command of PPU. In this case the honker built-in in PPU will be used for audio alarm.

The DU 1 with PPU 2 is located at persons exercising control of detection process automation, searching, localization, measuring, initial identification of gamma, X-ray and neutron radiation sources and checking connection with higher hierarchic system.

In the case of critical situations, for example, when the radiation permissible level is exceeded, or object forbidden to transportation is identified, DES automatically contacts with ENSEW 5. In this case the authorized persons have duty regulations pro-

viding object immediate localization and an immobilization.

The additional usage of scanner, for example, for scanning a bar code, makes it possible for an authorized person to increase input speed of the standardized information indicated by a bar code.

5       The opportunity of linking in PPU 2 and DU 1 in one housing allows an authorized person to localize and check objects in any place, where it is difficult to install the stationary detection units. Owing to that fact the system mobility is considerably improved. Moreover, the replacement of one detector in PPU construct by another, allows readjusting device quickly to the other radioactive radiation type. Thus the wire less  
10       communication of a DU 1 and PPE 2 allows to replace sensors without any wires commutation.

Usage Internet for open expert system arrangement allows to considerably save users material resources during system installation in control zones. In this case user purchases only detection units and preprocessing units, and can use computing re-  
15       sources in common user network. At that the open expert system can operate on a commercial basis.

Thus, usage of all characteristics allows to solve the set problem — to create the mobile and simultaneously powerful enough objects registration and identification system.

20       The technical documentation is prepared and the prototype models with smart-phone Mitac Mio 8380 are made.

The sources of information that were taken into consideration during expertise:

25       1. "X-Ray and Gamma Ray Detector High Resolution CZT Cadmium Zinc Telluride", web pages, amptek.com, Apr. 11, 2001, 8 pages.

2. "Charge Trapping in XR-100T-CZT Detectors Application Note", web pages, amptek.com, Apr. 18, 2001, 15 pages.


3. USA Patent No 6,668,277, G 06 F 013/00, 2003.

4. USA Patent No 4,550,381, G 01 S 13/74, 1985.

5. Patent on utility model, Russian Federation No 31001, G 01 T1/167, 2003  
(prototype).

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A handwritten signature in black ink, appearing to read 'Ed. Svidersky', with a date '28.01.04' written below it.